SOME EFFECTS OF THE INTRODUCTION OF THE FOUR-YEAR SOIL-CONSERVING CROPPING SYSTEM ON THE ORGANIZATION AND INCOME OF SELECTED FARMS IN SOUTHWESTERN OHIO

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TABLE OF CONTENTS

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One of the most commonly prescribed methods for conserving soil in Ohio is the use of a four-year rotation consisting of one year of corn, one year of small grain and two years of a mixed legume and grass meadow. This cropping system was seldom found in operation until recently, except where the demand for meadow crops was unusually heavy or the danger of erosion great. In most instances the cropping system used involved a larger proportion of the land in corn or other intertilled crops and a smaller proportion in sod crops.

What effects, other than that reflected in the soil, may the farmer anticipate who substitutes the four-year soil-conserving crop system for the one which he has been following? How will it alter his plan of operation, his labor requirements, his income? Obviously, the effects will vary from farm to farm, for few farms and farmers are identical. There are many farms and farmers, however, that resemble one another fairly closely and if we observe what takes place on a fairly typical farm it may give some indication what would take place on a similar farm.

Different approaches have been used to study the effects of the adoption of the four-year rotation. One method has been to compare similar farms on which different cropping systems are used. This method had the weakness that different managers, soil resources and livestock programs were involved. Another method has been to compare a period of operation before the four-year

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[1] This bulletin was constructed out of a more complete study under the same title which was submitted December, 1951, to the Graduate School of Ohio State University by Richard H. Follett in partial fulfillment of the requirements for the M.S. degree.

program was adopted with a period after it was in effect. This eliminated the weakness of difference in farms and managers in part, but had the weakness of dissimilar weather, prices, increased age of operator and advances in technology, as well as that of determining when the transition period is past and the new system fully established.

The method used in this study was to analyze the organization, labor use and income of specific farms over a period of years on which fairly typical crop and livestock systems had been employed and on which complete sets of records were available; then, by the process of budgeting, to substitute the four-year cropping system for the cropping system actually used on these farms. In making the substitution the following assumptions were made:

(1) that the quality of management be held as nearly as possible at the same level, as indicated by the production practices, yields, quality of livestock, level of stocking, marketing, etc., that had actually existed on the farm according to the records.

(2) that only those changes in the organization and operation of the farm would be introduced that were necessary to enable the proposed four-year rotation to function, plus the additional changes its installation would have necessitated and that would have been logical to expect this manager to make.

(3) that the same price and weather conditions be retained.

(4) that the proposed changes had been installed sufficiently long that the new plan could be fully in operation during the period covered by the study. In other words, the problems of the transition period were not considered.

The two farms selected for the study are located in southwestern Ohio. Both had detailed financial and fairly complete production records for a number of years. In each case the acres in the farm were the same throughout

the period analyzed. In addition to the information contained in the records, visits were made to the farms to collect data on the land (soil, drainage, topography, erosion, etc.) field layout, building facilities, labor force, production practices, markets, etc., not provided by the records.

FAYETTE COUNTY FARM

This farm contains 125 acres and is situated in central Southwestern Ohio. Its soil is about three fourths dark (Brookston silty clay loam) and one fourth light (Celina silt loam). It is nearly level with a few scattered knolls and is what would be considered adequately drained. All of the land in this farm is capable of being cropped without the use of mechanical erosion control devices such as terraces or contour strips.

There are two barns on the farm. One is a 50' x 56' loafing shed dairy barn combination with 13 stanchions; the other is a 56' x 60' general purpose barn. Together they have a combined capacity for 70-75 tons of loose hay. There is also a 14'-36' silo, crib space for 2000 bushels of corn and a modern tenant house and dwelling for the owner. The farm is laid out into 6 crop fields ranging from 9.2 to 25.9 acres, a small wood lot (1.4 acres) and the farmstead area.

During the 12 year period from 1939-1950 on which records were available the operator tended to follow a three-year rotation consisting of one year of corn plus small amounts of other intertilled crops, one year of small grain and one year of light mixed meadow. From the standpoint of type of farming his sources of income would have placed him in the classification of a dairy-hog, cash grain farm with hogs contributing 60%, dairy cattle and products 16%, and crops 15% of the receipts. He kept an average of 11 sows and 5 milk cows and employed the services of a full time hired man throughout the entire period. The farmer himself was well past middle age and preferred not to work to the limit of his capacity.

Crop yields, particularly that of corn, secured during the 12 years were above the county average. On the other hand, the production rates and the efficiency of livestock were somewhat below average, consequently contributed little to the net returns. For the entire period, 1939-50, the sales averaged $5635, expenses $2875, and farm income (after adjustment for change in inventory) $3990 per year.

Analysis of the Effect of the Substitution of the Four-Year Cropping System For That Employed on the Fayette County Farm

Field Arrangement.

The field layout as it existed provided three pairs of fields with nearly equal acreage for the three years in the rotation. The proposed plan provides four nearly equal fields, one for each of the years in the rotation. The change from the actual to the proposed plan would have been achieved by clearing the thin stand of trees in the small wood lot, incorporate it into the rotated area, and to relocate 140 rods of fence.

Crop Acreages.

As the farm was operated during the 12 year period an average of 36.6 acres of intertilled crops, 28.8 acres of small grain crops and 45.6 acres of sod crops were grown per year. Under the four-year program the proportion in each type of crop would have been significantly different. Both intertilled and small grain crops would have averaged lower throughout the period and meadow crops higher (see Table 1). In addition to the decreases in intertilled and small grain acreage the type of crop comprising each would also have differed. The intertilled crops grown consisted on the average of 31.0 acres of corn, 3.8 acres of soybeans, and .5 acres of peas; and the small grain averaged 19.9 acres of wheat, 5.8 acres of oats, and 3.1 acres of mixed grains. Under the proposed rotation the entire intertilled acreage of 28.8 would have been planted to corn and the 28.1 acres of small grain to wheat.

Table 1. Crop and Land Use Program Under the System Employed Compared With the Four-Year Rotation, Fayette County Farm

	12 Year Average 1939 - 1950	
	System Employed (Acres)	Four-Year Rotation (Acres)
Intertilled Crops		
Corn	31.0	25.9
Corn Silage	1.3	2.3
Soybeans	3.8	-
Peas	.5	-
Total Intertilled	36.6	28.2
Small Grain Crops		
Wheat	19.9	28.1
Oats	5.8	-
Mixed Grains	3.1	-
Total Small Grain	28.8	28.1
Meadow (hay and rotation pasture)		
Total meadow	45.6	56.1
Total rotated crop land	111.0	112.4
Wood Land	1.4	-
Farmstead roads, etc.	12.0	12.0
Total Farm Area	124.4	124.4

Fertility Program.

During the 12 years a total of 52 tons of lime and 36 tons of fertilizer were used. To function successfully the four-year rotation with its second year of meadow would have required sharply higher applications of lime and fertilizer. To maintain the calcium and other plant nutrient content of the soil sufficiently high to grow a mixed alfalfa-clover-timothy meadow in place of the light clover-timothy meadow grown, an annual application of 28 tons of lime and 8.5 tons of fertilizer would have been necessary. This would have required the purchase of 284 tons more lime and 66 tons more fertilizer during the 12 year period than was actually purchased according to the farm records. The initial application of both lime and fertilizer needed to put the soil in

condition to grow the mixed alfalfa-clover-timothy meadow would have been in addition to the above and would have been made during the transition period which is assumed to have preceded 1939.

Yields and Production.

Under the three-year rotation and the fertility program employed the 12 year average corn yield was 71 bushels per acre, wheat 23 bushels and the meadow based on the farmers rate of stocking, yielded hay and pasture to support one forage consuming unit per each 4.8 acres. With the injection of alfalfa into meadow mixture, the larger proportion of the cropland seeded to meadow and the accompanying heavier applications of lime and fertilizer it was estimated that the corn would have yielded 85 bushels, the wheat 25, and the meadow supported one forage consuming unit per each 3.8 acres during the same period under the proposed four-year soil-conserving rotation[1] (see Table 2.) Total production of corn would have been about the same under either rotation (see Table 2). To attain this situation, however, it was necessary to devote the entire intertilled acreage to corn thus eliminating the soybeans and peas which were sources of income as the farm had been operated. Approximately 50 percent more wheat and meadow crops would have grown under the proposed plan but in the case of wheat a major share of the increase was derived from the acres shifted out of oats and mixed grains into wheat which was considered to be more profitable on the basis of yield history on this farm.

Disposition of Crops.

Between 1939 and 1950 the operator reported total crop sales of $10,226. Cash crops (wheat, soybeans, rye, peas, and grass seed) accounted for $8,954

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[1] These estimates are based on the yields attained in numerous Agronomy experiments on similar soils and on farmer experience in that section of the state as observed by Agronomy Extension Specialists.

Table 2. Crop Acres, Yield and Production, Under the System Employed and Under the Four-Year Rotation, Fayette County Farm

	12 Year Average 1939 - 1950					
	System Employed			Four-Year Rotation		
	Acres	Yield Per Acre	Total Procuction	Acres	Yield Per Acre	Total Production
Corn grain	31.0	71.4 Bu.	2214 Bu.	25.9	85.0 Bu.	2201 Bu.
Corn silage	1.3	10.7 Tons	14 Tons	2.3	11.3 Tons	25.9 Tons
Soybeans	3.8	24.0 Bu.	93 Bu.	-	-	-
Peas	.5	.8 Tons	.4 Tons	-	-	-
Wheat	19.9	23.1 Bu.	460 Bu.	28.1	25.0 Bu.	703 Bu.
Oats	5.8	24.2 Bu.	141 Bu.	-	-	-
Mixed grain	3.1	18.0 Bu.	56 Bu.	-	-	-
Hay and Rotation pasture*	45.6	.22 A.U.	10 A.U.	56.1	.29 A.U.	16 A.U.

* Yield measured in terms of actual forage consuming animal units carried.

and feed crops (corn, oats, and hay) $1272. Practically all of the feed crops produced were fed on the farm. In only 3 years out of the 12 was there any corn or oats sold. Under the proposed program the same general disposition of the crop was carried out. All of the feed crops (corn and meadow) would be disposed of through livestock. In the case of cash crops (wheat only) the same quantity would be fed each year under the proposed as under the actual plan with the balance except that needed for seed, being sold. This would have made available an average of 140,180 pounds of all types of grain per year for disposition through livestock in the proposed setup as compared with an average of 147,440 pounds of grain per year actually disposed of through livestock.

Livestock.

The livestock program employed was fairly typical of many farms of this size in western Ohio except that this operator tended to stock his farm less heavily with forage consuming animals than his pasture and meadow would support. Between 1939 and 1950 the farmer's inventory on the first of the year listed an average of 9.7 forage consuming animal units consisting of 2.2 head of horses, 5.2 head of milk cows and 4.6 head of steers, bulls and replacements. In addition, it also listed an average of 11 sows and gilts (operated under the two litter system) and 41 chickens. Throughout the period analyzed the milk was sold in a class III market.

Under the proposed cropping system with its slightly lower supply of grain for feeding and 50% greater meadow crop production, some changes in the livestock program would be necessary to enable the farmer to utilize the same relative proportion of the feed. With more forage to be disposed of an expansion in his forage consuming livestock would be necessary. Since there was no occasion to increase either the number of horses or bulls kept and since in actual practice he had discontinued feeding any beef

cattle by 1944 and begun to expand his dairy, it was assumed it would have been his dairy that he would have enlarged to utilize the meadow crop had he been on the four-year rotation. To have utilized the same relative proportion of the meadow and pasture production that was actually consumed he would have stocked an average of 15.7 forage consuming units in place of the 9.7 reported. These would have consisted of the same number of horses, bulls, and beef animals but 9.7 cows instead of 5.2 and 6.6 head of replacement stock instead of 3.5 head. (See Table 3).

Table 3. Livestock Under the System Employed and Under the Four-Year Rotation, Fayette County Farm

	12 Year Average 1939 - 1950	
	System Employed (number)	Four-Year Rotation (number)
Dairy cows	5.2	9.7
Dairy replacements	3.5	6.6
Bulls	.4	.4
Steers	.7	.7
Hogs marketed (220# weight)	103.3	84.3
Horses	2.2	2.2
Chickens	41.0	41.0

The expansion in the dairy enterprise would have increased the quantity of home grown grain utilized by the forage consuming animals over that fed while on the three-year cropping system. This would have further reduced the grain available for his swine enterprise. Since his record of performance indicated a definite tendency for him to keep his livestock program in balance with his feed supply rather than to purchase feed, a second adjustment was necessary, namely, a reduction in his hog enterprise from 103 hogs marketed per year to 84.3.

In arriving at livestock numbers for the proposed plan the same rates of forage, grain, and supplement feeding were used as employed by the farmer during the 12 years on which farm records were available. Likewise, in determining the amount of livestock and livestock products for sale, the same production rates per animal were used. This permitted the same changes in efficiency to take place under the proposed plan that occurred under the actual one.

Labor Requirement

On the basis of production method employed and equipment available, an average of 4570 hours of man labor per year were required to perform the crop, livestock and miscellaneous and maintenance work involved. Using the same techniques and equipment the amount of man labor needed to carry out the revised setup would have averaged 5219 hours per year (see Table 4).

Table 4. Man Labor Required Under the System Employed and Under the Four-Year Rotation, Fayette County Farm

	12 Year Average 1939 - 1950	
	System Employed (Hours)	Four-Year Rotation (Hours)
Crops		
Corn	1024	895
Other intertilled	176	-
Small grain	81	78
Meadow	100	133
Total Crop	1381	1106
Livestock		
Dairy enterprise	1182	2053
Hog enterprise	751	674
Other animals	342	342
Total Livestock	2275	3069
Maintenance and Miscellaneous	914	1044
Total Crop, Livestock, Maintenance and Miscellaneous	4570	5219

The increased hours needed to operate the proposed plan would have arisen from the expansion in the dairy enterprise and from an increase in the maintenance and miscellaneous work that would have occurred under the proposed plans. Fewer hours would have been needed to produce the crops and to tend the swine enterprise in the proposed setup than in the one actually used, but the decrease due to less intertilled and small grain acres and to a smaller hog enterprise would not have been sufficient to offset the increase created by the expanded dairy and the larger hay acreage.

Under the plan actually carried out by the farmer, an excess of labor prevailed throughout most of the period. At no time did he hire labor in addition to his full time hired man. There were a few brief periods due to year to year fluctuations in crop production and livestock number when it was used at near capacity. Assuming the same relative fluctuation in crop production and livestock numbers in the proposed setup as the records indicated had prevailed under the three-year setup, the labor requirements would have exceeded the supply in 3 of the 12 years. In these years it would have been necessary to employ additional labor. In the other 9 the supply would have been adequate to more than adequate to handle the added work.

Capital Investment

To install successfully the four-year program and carry out the alterations in the organization that would arise therefrom, an additional capital investment of $1100 would have had to be made. First, an initial application of lime, sufficient to make possible the growth of alfalfa would have required an outlay of $840. Second, the alteration in field layout would have cost an estimated $160 in fencing materials and third, the initial expansion in the dairy enterprise would have necessitated an expenditure of $100 for two more dairy cows.

Building facilities for storing the increased quantity of meadow crop

and for housing the larger dairy herd were already available. No alterations would have been required to enable the proposed system to function.

Receipts

A total of $67,620 were taken in by the farmer during the 12 year period 1939-50. Hogs, crops, and milk were the major sources with hogs contributing approximately 60% of the total (see Table 5). Assuming the estimated produc-

Table 5. Receipts Under the System Employed and Under the Four-Year Rotation, Fayette County Farm

	12 Year Average 1939 - 1950			
	System Employed		Four-Year Rotation	
	Dollars	Percent	Dollars	Percent
Hogs	3370	59.8	2884	49.4
Milk	753	13.3	1484	25.4
Dairy Animals	165	2.9	285	4.9
Crops	852	15.1	685	11.8
Poultry	130	2.3	130	2.2
Beef	86	1.5	86	1.5
Horses	7	.2	7	.1
Government Payments	161	2.8	161	2.8
Labor off farm	100	1.8	100	1.7
Miscellaneous	11	.2	11	.2
Total Receipts	$5635	100.0	$5833	100.0

tion under the proposed program to have been marketed through the same channels and at the same prices as those used and received for the products sold from the three-year program, the total taken in would have been $69,996, or $2,375 more than was actually received. Under the proposed plan the dairy enterprises would have contributed $10,223 more than under the actual

setup but both the hog enterprise and crop sales would have contributed less because of fewer hogs and less crops for sale.

Expenses

The total expense incurred during the 12 year period amounted to $34,560. Wages of the full time hired man was the largest single item followed by building and machinery depreciation, real estate taxes, machine hire and purchased feed. Approximately three fourths or $23,856 of the total expense consisted of items that would have remained practically the same under the proposed rotation. These included the wage of the regular hired man, real estate taxes, depreciation, building repairs, insurance, farm auto expense, electricity and telephone. The balance of the costs, lime, fertilizer, seed purchased, feed, machine hire, extra hired labor, purchased livestock, veterinary service and fuel and oil would have differed in some degree under a four-year rotation because of the differences in acreages, fertility program, livestock numbers, etc. Of these, lime, fertilizer, extra hired labor, and machine hire would have been sharply higher, whereas, seed, fuel and oil, and machinery repair would have been slightly less in each case (see Table 6, page 14). The increase in machine hire would have been due to the greater acreage of wheat straw baled to insure a good meadow, to an increased tonnage of hay baled, and to more silage made for the expanded dairy.

Fewer acres of intertilled and small grain crops to be planted, tended and harvested cut the use of power and equipment more than the enlarged meadow increased it. Likewise, under the four-year system less seed would have been needed on all three types of crops since there were less acres of intertilled and small grain grown and only 25% of the cropland would have been seeded to meadow each year in place of 30-35 percent. Purchased feed expenditures would have been only slightly higher under the proposed than

Table 6. Expenses Under the System Employed and Under the Four-Year Rotation, Fayette County Farm

	12 Year Average 1939 - 1951			
	System Employed		Four-Year Rotation	
	Dollars	Percent	Dollars	Percent
Expenses affected by change				
Lime	18	.6	113	3.3
Fertilizer	114	4.0	301	8.8
Seed	172	6.0	139	4.1
Purchased feed	144	4.5	158	4.6
Purchased livestock	78	2.7	95	2.8
Machine line	149	5.2	254	7.5
Fuel and oil	97	3.4	88	2.6
Machine repair and fence	75	2.6	68	2.0
Extra hired labor	0	-	142	4.2
Interest on new investment	0	-	14	.4
Veterinary Service	45	1.6	43	1.3
Expenses unaffected by change				
Taxes	152	5.3	152	4.5
Farm share of auto	126	4.4	126	3.7
Building repairs	119	4.2	119	3.5
Insurance	30	1.1	30	0.9
Electricity	43	1.5	43	1.3
Telephone	8	.3	8	.2
Building Depreciation	191	6.7	191	5.6
Machinery Depreciation	224	7.8	224	6.6
Regular hired labor	1057	36.7	1057	31.1
Miscellaneous	38	1.3	38	1.1
Total expenses	2880	100.0	3403	100.0

under the actual plan because the reductions in the swine enterprise partially offset the increase in the dairy.

Change in Inventory

On January 1, 1939, crop and livestock on hand were valued at $2,661. At the end of the 12 year period they were valued at $5,998. Considerably more crops were on hand at the beginning than at the close of the period. On the other hand there were somewhat more livestock on hand at the end than at the beginning.

Bare land was carried on the record on January 1, 1939, at $5600, building and fences $6200 and machinery and tools at $910. During the ensuing 12 years these values were raised by the farmer to $14,000 for the bare land, $6850 for the building and fences and the machinery and tools to $3280. These items together with the crops and livestock totaled $15,371 on January 1, 1939 and $30,128 on December 31, 1950. The increase of $14,757 for the most part was due to the change in prices rather than changes in quantity or quality.

Under the method used in making the comparison between the two systems it was assumed that the installation of the proposed four-year plan would have started in the middle 1930's and would have been fully established by 1939. Consequently, by 1939 both the crops and livestock that would have been on hand would have differed somewhat from that reported. Had the proposed program been fully established on January 1, 1939, the inventory of crops and livestock would have been $2968 or $307 greater than was actually recorded.

At the close of the period more crops and several head more livestock would have been on hand had the four-year program been operated than was recorded for the three-year setup. This larger quantity and number would have invoiced at $6,925 or $927 more than under the three-year program.

The total inventory, using the same values for land fixtures and equipment as the farmer listed in his records, would have been $15,678 on January 1, 1939, and $31,055 on December 31, 1950, under the proposed program.

Farm Income

Net income (gross receipts less expenses) actually realized from the farm as operated amounted to $3900 more for the 12 year period studied or $325 more per year than the net income that would have been realized

during the same period had the farm been operated under the four-year rotation. The total realized net income for the period was $33,060 and the farm income (receipts less expenses adjusted for change in inventory) was $47,817 (see Table 7) or $3985 per year. The total estimated net income for the

Table 7. Farm Income Under the System Employed and Under the Four-Year Rotation, Fayette County Farm

	12 Year Total 1939 - 1950	
	System Employed (dollars)	Four-Year Rotation (dollars)
Gross Receipts	$67,620	$69,996
Expenses	34,560	40,836
Net Receipts	33,060	29,160
Inventory Change	⁄14,757	⁄15,377
Farm Income Total	47,817	44,537
Farm Income Per Year	3,985	3,711

same period under the four-year crop program would have been $29,160 and the farm income $44,537 or $3,711 per year.

On an hourly basis the farm income per hour worked was $.87 for the crop program actually followed, and $.74 per hour for the proposed four-year program.

The increased yield per acre of crops and the enlarged dairy did not contribute enough more to the sales to offset the decrease in receipts resulting from smaller cash crops and hog sales to overcome the higher expenses growing out of the new program.

DARKE COUNTY FARM

The Darke County Farm is situated in west central Ohio near the Indiana line. It contains 100 acres of nearly level to slightly rolling land with only a few acres having as much as 7 percent slope. Except for these few acres of moderately steep land, erosion losses have not been significant and do not present a serious problem in utilizing the land. Currently all of the land is rotated except 12 acres of permanent pasture and the 3.5 acres in farmstead and roads.

Soils are predominantly light colored with about 40 acres of Crosby silt loam. Only 10 acres of dark or Brookston silt loam are present with the balance divided about equally between Bellefontaine and Miami silt loam. About half of the farm would require liming at the rate of one ton per acre to grow alfalfa. The lime content on the remaining 50 acres when tested was adequate. All of the cropland samples tested were low in phosphorus and except the Brookston samples, low in organic matter.

The farm is equipped with a modern dwelling and generally adequate service buildings. The farm service buildings consist of a 40' by 60' bank type barn in fairly good condition with storage capacity for 60-70 tons of loose hay. It is not well equipped for dairying, however, and can only qualify for the class III milk market. Reasonably adequate space exists for machine storage and sufficient crib and bin space exists for 3000 bushels of corn and 800 of small grain. There is also a 16' x 20' poultry house.

Five crop fields varying in size from 11 to 20.5 acres and 2 permanent pasture fields comprise the farm layout. Farm operations have been carried on under a crop share rental arrangement for many years with one half of the crops including hay being sold by the landlord. Under this arrangement the farm has been farmed rather heavily with over 50 percent in intertilled crops and not more than 25 percent devoted to sod crops. Crop sales (tenant plus

landlord) contributed 34 percent, dairy cattle and products 26 percent, hogs 21 and poultry 16 percent of the receipts during the 6 year period analyzed.

Analysis of the Effect of the Substitution of the Four-Year Cropping System For That Employed on the Darke County Farm

Field Arrangement

Eighty-four and one-half acres of the 100 acres in the farm were used for crops, 12 acres for permanent pasture with the balance in farmstead woods, etc. during the period studied. No change would be necessary in this to convert the farm to the proposed four-year program. Considerable alteration, however, in field arrangement would be necessary to secure a workable field layout. By moving 290 rods of fence it would be possible to block out three 20-acre fields, an 11-acre field, and a 13-acre field with the latter two fields planted to the same crop to make the fourth unit. The revised arrangement would also have permitted farming across rather than up and down the slopes.

Crop Acreages

The substitution of the four-year rotation for the cropping system followed would have resulted in a marked difference in crop acreage. An average of 35 acres of corn were grown per year between 1945 and 1950. A four-year program would have cut this to 21.4 acres (see Table 8, page 19). Small grain acreage would not have been greatly altered but the acreage in meadow would have been doubled by the proposed program. Soybeans which had played a prominent role as the farm was operated would have been discontinued.

Fertility Program

An average of four tons of fertilizer or 108 pounds per crop acre were applied per year and no lime was used during the six years according to the farmer's records. To have successfully substituted the proposed rotation with its two years of legume meadow, more lime and fertilizer would have had to be

Table 8. Crop and Land Use Program Under the System Employed Compared with the Four-Year Rotation, Darke County Farm

	6 Year Average 1945 - 1950	
	System Employed (Acres)	Four-Year Rotation (Acres)
Intertilled Crops		
Corn	35.3	21.4
Soybeans	9.8	0
Total Intertilled	45.1	21.4
Small Grain Crops		
Wheat	4.3	4.7
Oats	14.3	16.8
Total Small Grain	18.6	21.5
Meadow (hay & rotation pasture)		
Total meadow	20.8	41.6
Total Rotated Crop Land	84.5	84.5
Total Permanent Pasture	12.0	12.0
Farmstead Roads, etc.	3.5	3.5
Total Farm Area	100.0	100.0

spread. Inasmuch as only half of the land is currently deficient in calcium, an average annual application of only 12.5 tons of lime per year would have been needed after the initial treatment. To have provided the other plant nutrients needed to grow the type of legumes used in the four-year rotation would have required an average application of 6.9 tons of fertilizer per year as compared to the 4.0 tons actually applied.

Yields and Production

For the six year period grain crop yields were as follows: corn, 65.8 bushels; oats, 37; wheat, 26.2; and soybeans, 24.4 bushels. Had the four-year soil-conserving rotation been fully in effect during these same 6 years and had the fertility program needed to make it function been employed it is estimated that the grain yields would have been as follows: corn, 72 bushels;

oats, 45 bushels; and wheat, 30 bushels. Pasture yields would have been 34 percent greater and hay 115 percent greater.

In the case of the grains the increased yield was not sufficient to offset the effect of reduced acreages. As the farm was operated 504 tons of all types of grain were produced between 1945 and 1950. But under the four-year program only 357 tons would have been produced (see Table 9, page 21).

The only grain crops to register increases in total bushels were oats and wheat. Soybeans were not included in the four-year plan and the sharply reduced acres of corn (35.3 acres per year to 21.4 acres) cut the bushels of corn grown by 33.7 percent. On the other hand, meadow production would have more than tripled that which was actually produced. This sharp increase would have been due to both higher yields and by doubling the acres in rotated sod crops.

Disposition of the Crops

During the six years covered by the study, the Darke County Farm was operated by a tenant who leased the farm on the standard one-half crop share method. All crops including the hay were divided half and half, with the landlord selling his share on the market. The tenant disposed of all of his feed grain and hay through the livestock which his lease permitted him to keep, except in 1949 when a few bushels of corn were sold. His cash crops--soybeans, wheat and clover seed--were all sold except the few bushels of wheat that were fed and used for seed.

Under the proposed program the same arrangements for the disposition of crops was carried out. The landlord's half was set aside for sale and the tenant's feed grains, hay and pasture were allocated to livestock. The same quantity of the tenant's cash crops, wheat, would be fed as indicated in the records of the actual operation with the balance sold. This would have made available 54,253 pounds of feed grain plus meadow and pasture sufficient to

Table 9. Crop Acres, Yield and Production Under the System Employed and Under the Four-Year Rotation, Darke County Farm

	6 Year Average 1949 - 1950					
	System Employed			Four-Year Rotation		
	Acres	Yield Per Acre	Total Production	Acres	Yield Per Acre	Total Production
Corn	35.3	65.8 bu.	2323	21.4	72 bu.	1541
Soybeans	9.8	24.4 bu.	239	-	-	-
Oats	14.3	36.7 bu.	526	16.8	45 bu.	756
Wheat	4.3	26.2 bu.	113	4.7	30 bu.	141
Meadow						
Pasture	8.3	99 days	825 days	17.0	133 days	2261 days
Hay	12.5	1.3*	16.2 tons	24.6	2.8 tons	69 tons
Total Meadow	20.8			41.6		

* One cutting, meadow aftermath pastured.

support 21.5 units of forage consuming livestock per year as compared with 69,340 pounds of feed grain plus meadow and pasture to support 10.6 units of forage consuming livestock per year as actually operated.

Livestock

The livestock kept consisted of a 6 cow dairy producing grade III milk, a swine enterprise made up of 2 brood sows plus a few purchased feeders and a poultry flock of approximately 160 layers. With 19 percent less pounds of feed grain available and more than double the quantity of hay and pasture to be utilized, a considerably different livestock program would have had to be employed for the four-year crop program than was actually used. Inasmuch as the Darke County farmer had already elected to keep dairy cattle rather than beef or sheep to use his hay and pasture it was assumed that he would have expanded his dairy to consume the increased forage had he been operating under the four-year system between 1945 and 1950. Stocked to the same percentage of carrying capacity he would have had 13 cows and 15 head of other dairy stock. (See Table 10 below) This would have been slightly more than double

Table 10. Livestock Under the System Employed and Under the Four-Year Rotation, Darke County Farm

	6 Year Average 1945 - 1950	
	System Employed (Number)	Four-Year Rotation (Number)
Dairy Cows	5.9	13.1
Dairy Replacements	6.8	15.0
Bull	.6	.6
Beef Steers	.8	.8
Horses	.4	.4
Hogs Marketed (220# Weight)	32.3	11.3
Chickens	160.0	160.0

that actually carried, therefore, would have required approximately double the amount of feed grain for his forage consuming livestock. With less feed grain to start with and the increased consumption by the dairy the amount

remaining for hogs and poultry enterprises would have in inadequate to maintain them at the same level as actually carried. To allow for this, the assumption was made that he would retain his fairly efficient poultry enterprise and make the adjustment in his hog enterprise by eliminating the brood sows but continuing the practice of purchasing feeder pigs to utilize any surplus feed grain available.

Labor Requirements

The introduction of the four-year soil conserving cropping system would have altered considerably the labor requirements and distribution of work throughout the year. As the farm was actually operated the farmer and his wife were able to do most of the work. This is indicated by the fact that only $30 of extra labor was hired per year. Based on the equipment and production methods used there were 670 hours of crop, 2,172 hours of livestock and 706 hours of maintenance and miscellaneous work, or a total of 3,548 hours to be done each year. (See Table 11, page 24).

Under the proposed system the time spent on crop production would have been slightly less with a major shift from spring and fall work on corn and soybeans to greatly increased summer work on hay harvest. The slight decrease in crop work and the reduction in the hog enterprise would have been lost in the sharp rise in time required to care for the expanded dairy and increased acreage of hay. Only by assuming that the Darke County farmer would have shifted from hand to machine milking -- a practice adopted by many farmers during the 1940's would it have been possible to make the program workable. For this farmer to have continued the practice of hand milking with the larger herd would have raised the regular work load above that which he and his wife could handle but not sufficient to justify the employment of a full time hired man. With machine milking the total work load still exceeded by more than 300 hours per year the program actually

Table 11. Man Labor Required Under the System Employed and Under the Four-Year Rotation, Darke County Farm

	6 Year Average 1945 - 1950	
	System Employed (Hours)	Four-Year Rotation (Hours)
Crops		
Corn	473	366
Soybeans	88	-
Wheat	12	13
Oats	40	47
Meadow	57	230
Total Crops	670	656
Livestock		
Dairy Cows	1254*	1529**
Dairy Replacements	122	269
Other Cattle and Horses	94	94
Hogs	174	34
Poultry	528	528
Total Livestock	2172	2454
Maintenance and Miscellaneous Work	706	770
Total Crop, Livestock, Maintenance and Miscellaneous Work	3548	3880

* Hand Milked
** Machine Milked

followed, thus necessitating both longer hours and an increased employment of seasonal labor.

Capital Investment

To establish the four-year crop system and the revised livestock program on the Darke County farm would have involved an outlay of approximately $1700. This would have arisen from the cost of changes in field layout, initial lime application, expansion in the dairy herd and the purchase of a milking machine. Sufficient housing space would have been available for both the increased production of hay and the expanded dairy herd without additional investment of capital.

Receipts

Total receipts from the farm, (tenant + landlord) averaged $7778 per yea for the six year period covered by the analysis (see Table 12 below). Of this the tenant received $5511 per year and the landlord, $2267. Practically all of the tenant's receipts were derived from the sale of livestock and livestock products, whereas, the landlord's receipts were all derived from crops. Hogs were the tenant's largest source of income and corn was the landlord's major source.

Table 12. Receipts Under the System Employed and Under the Four-Year Rotation, Darke County Farm

Source of Receipts	6 Year Average 1945 - 1950			
	System Employed		Four-Year Rotation	
	Dollars	Percent	Dollars	Percent
Milk	1387	17.8	3030	34.8
Dairy Animals	626	8.0	1315	15.1
Hogs	1670	21.5	525	6.0
Poultry	1251	16.1	1251	14.4
All Other Livestock	43	.6	43	.5
Corn	1530	19.7	1014	11.6
Oats	229	2.9	328	3.8
Wheat	153	2.0	250	2.9
Soybeans	458	5.9	0	0
Hay	149	1.9	743	8.5
Seed Crops	77	1.0	0	0
Miscellaneous	205	2.6	205	2.4
Total	7778	100.0	8704	100.0

During the same six year period it is estimated that receipts would

have averaged $8704 per year had the four-year soil-conserving cropping system and the revised livestock system been employed (see Table 12, page 25). The tenant's share of the receipts would have averaged $6468 and the landlord's, $2236. In arriving at the estimated receipts for the proposed plan the same market outlets and prices were used as indicated in the farmer's records. Neither the quality of livestock nor the feeding or marketing practices were altered, only the size of these enterprises were changed. The landlord's share of all crops was considered to be sold, including the much increased hay crops.

Dairy receipts would have been the tenant's major source of income with poultry second and hogs third. Corn would still have remained the landlord's largest source of receipts, however, hay sales would move from 4th to 2nd place.

Expenses

Average annual expenditures recorded during the six year period amounted to $2999 (tenant / landlord). Under the proposed four-year program the average annual expenses for the same period are estimated at $3328 (tenant / landlord). Many of the items for which money was paid out such as taxes, insurance, building depreciation, etc. would have remained essentially the same (see Table 13, page 27). On the other hand, the outlay for operating items such as seed, fertilizer, feed purchased, etc. would have been altered. Seed, fuel and oil, machinery repair and livestock purchased would have been less under the proposed setup. Offsetting these were increases in fertilizer, feed purchased, machinery and hired labor. Also, two new items of cost would have been added, namely, lime and interest on the added capital investment.

Under the proposed plan both the tenant and the landlord would have had larger annual expenses than were recorded for the plan followed. The tenant's share of the total costs would have risen from $2530 to $2770 per year and

Table 13. Expenses Under the System Employed and Under the Four-Year Rotation, Darke County Farm

	6 Year Average 1945 - 1950			
	System Employed		Four-Year Rotation	
	Dollars	Percent	Dollars	Percent
Expenses affected by change				
Lime	0	0	53	1.6
Fertilizer	174	5.8	279	8.4
Seed	153	5.1	137	4.1
Purchased feed	670	22.4	743	22.3
Purchased livestock	500	16.7	314	9.4
Machine hire	227	7.6	347	10.4
Fuel and oil	187	6.3	172	5.2
Machine repair	130	4.3	120	3.6
Hired labor	30	1.0	149	4.5
Interest (on added investment)	0	0	86	2.6
Expenses unaffected by change				
Taxes	132	4.4	132	4.0
Electricity	64	2.1	64	1.9
Telephone	28	.9	28	.8
Insurance	51	1.7	51	1.5
Farm share of auto	172	5.6	172	5.2
Veterinary	26	.9	26	.8
Field and Fence repairs	39	1.3	39	1.2
Building depreciation	81	2.7	81	2.4
Machinery depreciation	241	8.1	241	7.2
Miscellaneous	94	3.1	94	2.8
Total Expenses	2999	100.0	3328	100.0

the landlord's from $469 to $558. Larger outlay for fertilizer, machine hire (hay baling) and the addition of lime costs would have more than offset the small reduction in the landlord's seed costs. In the case of the tenant, larger outlays for fertilizer, feed, machine hire, hired labor and lime more than cancelled out his savings in seed, livestock purchased, gas and oil and machine repairs.

Inventory Change

On January 1, 1945, the total value of all crops, livestock and equip-

ment on the farm (tenant share only*), plus the real estate was listed at $9,648. On December 31, 1950, the total value recorded for these items was $15,216. This increase was due primarily to (1) more crop and livestock on hand at the end than at the beginning of the six year period, (2) higher per unit prices and (3) more farm machinery. No change was made in land value by the farmer during the six year period. In the case of buildings and fixtures, depreciation had been about offset by improvements.

Since it has been assumed that the proposed four-year program was initiated sufficiently long before January 1, 1945 to have passed through the transition stage and, therefore, to be in full operation at the beginning of 1945, the crops and livestock on hand would have been somewhat different from that reported. Based on the expected crop acreage, production, and the disposition of these crops, it was estimated that on January, 1945, the inventory of crops, livestock and equipment (tenant's share only) ∕ the real estate would have amounted to $10,940 or $1292 greater than the actual beginning inventory. This difference was due to enough more oats, hay and straw to offset a lower corn supply, to 10 cows instead of 5, and to the addition of the milking machine to the list of equipment. On December 31, 1950, the value of the crops, livestock, equipment (tenant's share only) and the real estate was estimated at $15,886. Most of the increase between the beginning and the closing inventory of the proposed four-year plan can be accounted for by increase in price rather than change in quantity or number. Part of it, however, was due to larger supply of crops on hand at the end than at the beginning due to the very good crop production in 1950.

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* The farm records from which the material used in the study is drawn do not contain data on the landlord's inventory. Instead they recorded all of his crop as currently sold each year, thus the landlord would have no change in inventory to consider since his real estate was carried the same throughout the entire period.

Table 14. Farm Income Under the System Employed and Under the Four-Year Rotation, On the West Central Ohio Farm

	6 Year Total 1945 - 1950					
	Total Farm Tenant and Landlord		Tenant Share		Landlord Share	
	System Employed	Four-Year Rotation	System Employed	Four-Year Rotation	System Employed	Four-Year Rotation
Gross receipts	46,668	52,224	33,068	38,810	13,600	13,414
Expenses	17,994	19,968	15,182	16,621	2,812	3,347
Net receipts	28,674	32,256	17,886	22,189	10,788	10,067
Adjustment for Inventory Change	⁄5,568	⁄4,946	⁄5,568	⁄4,946	None*	None*
Farm Income	34,242	37,202	23,454	27,135	10,788	10,067
Farm Income Per Year	5,707	6,200	3,909	4,522	1,798	1,678

* The farm records from which the material used in the study is drawn do not contain data on the landlord's inventory. Instead they recorded all of his crop as currently sold each year. Since no change was made in real estate value betweer 1945 and 1950 no change occurred in the landlord's inventory between January 1, 1945, and December 31, 1950.

Farm Income

Between January 1, 1945, and December 31, 1950, the net difference between receipts and expenses adjusted for change in inventory or farm income (tenant / landlord) amounted to $34,242 or $5,707 per year (see Table 14, page 29). Had the proposed four-year program been fully in operation during this period, it is estimated that the total farm income would have amounted to $37,202 or $6200 per year. This would have been an increase in farm income of $493 per year over the plan actually employed.

The tenant's farm income under the proposed four-year rotation would have averaged $613 per year higher than under the system actually employed, whereas, the landlord's farm income would have averaged $120 per year less.

The more favorable effect of the employment of the proposed four-year rotation on the tenant's income than the landlord's was primarily due to the fact that the landlord participated only in the salable crops which were lower in value under the proposed than under the plan actually employed. The increase estimated to take place under the four-year rotation occurred in larger dairy receipts all of which accrued to the tenant under the crop share lease employed.

On an hourly basis the tenant's "farm income", plus wages paid hired labor, amounted to $1.11 per hour worked as the farm was actually operated and to $1.20 under the proposed four-year system.

SUMMARY

On both of the farms on which the effect of the introduction of the four-year cropping system on the organization and income was analyzed, the following effects were observed:

1. Some rearrangement in field layout was necessary.
2. A significant reduction in the acreage intertilled crop and an increase in meadow crop occurred.
3. Soybeans were eliminated from the crop program in favor of corn.
4. Sharply higher amounts of lime and fertilizer were needed to make the four-year program function.
5. Yields per acre average higher on all crops.
6. Annual tonnage of feed grains produced was less and their forage production was greater.
7. Less cash crops were available for sale.
8. Forage consuming livestock (dairy cattle in both instances) increased and the major concentrate consuming livestock (hogs in both instances) decreased.
9. Annual labor required was considerably larger and distribution throughout the growing season was less uniform.
10. A larger investment of capital was needed.
11. Both the average annual farm sales and expenses were higher.
12. The average annual net farm income on one farm would have been less favorable and on the other farm more favorable than under the system actually employed.
13. On the farm which was rented on a crop share basis, the net farm income of the tenant who was permitted to keep sufficient livestock to utilize his share of the feed would have been distinctly higher while the landlord's net farm income would have been lower.

CONCLUSION

The major effects of the proposed introduction of the four-year cropping system into the organizations of the two farms analyzed would have been to change significantly the type of farming, to increase both the capital and labor requirements, to alter the income received, and to establish definite soil maintaining programs on both farms.

The chief factor apparently responsible for the difference in the effect on income was the difference in the ability of the men. Based on their crop yield index both men were doing a better than average job of producing crops. But as a livestock producer the Fayette County farmer, whose income would have been lower, was below average particulary as a dairy man, while the Darke County farmer, whose income would have been higher, was somewhat above average as a livestock producer. The Fayette County farmer's 12 year average annual butterfat sales per cow was 209 pounds as compared to a 6 year average of 282 pounds average per cow on the Darke County farm. A further indication of differences in their ability as livestock producers, although not entirely comparable, was the return per dollar of feed fed which averaged $1.28 on the Fayette County farm as compared to $1.85 on the Darke County farm.